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Title of Invention: Bonding Material for Electronic Parts and Electronic Equipment Using the Material

Number of Claims: 2

Scope of Claim

[What is claimed is]
Claim 1

A bonding material for electronic parts wherein conductive particles are dispersed and contained in an insulating resin base material wherein conductive shape memory alloy particles are used as the conductive particles.

Claim 2

Electronic parts and electronic equipment comprising bonding parts that are electrically bonded by the bonding material for electronic parts of Claim 1.

["Prior Art" section is omitted from this translation]

(0006)
Problems the Invention is Intended to Resolve

In light of the problems in the prior art, an objective of the present invention is to provide a bonding material for electronic parts and electronic equipment using [this bonding material] that eliminates conductivity defects in electronic parts and electronic equipment due to the occurrence of gaps between conductors, even when used in environments in which thermal cycling occurs, and moreover it is a further objective to improve the vibration resistance thereof.

(0007)
Means of Solving the Problems

The bonding material for electronic parts of this invention comprises conductive particles which are dispersed and contained in an insulating resin base material wherein conductive shape memory alloy particles are used as the conductive particles.

(0008)

Furthermore, the electronic parts and electronic equipment of this invention comprises bonding parts that are electrically bonded by this bonding material for electronic parts.

(0009)

Operation of the Invention

Since the bonding material for electronic parts of this invention comprises conductive particles which are dispersed and contained in an insulating resin base material, due to the shape recovery ability of the shape memory alloy contained therein (hereinafter simply "the shape recovery ability"), there is no deformation and formation of gaps attendant on increases in the volume of the insulating resin base material, and there is no formation of cracks and the like, even under conditions in which thermal cycling occurs. Therefore, excellent conductivity of the bonded parts can be maintained. Moreover, the vibration resistance of the bonded parts can be improved since the shape memory alloy has elasticity under conditions of use.

(0010)

Since the electronic parts and electronic equipment of this invention (hereinafter "the electronic equipment") are bonded by this bonding material for electronic parts, conductivity defects do not occur, even when used under environmental conditions of thermal cycling, and the vibration resistance is excellent. Thus, it affords reliability.

(0011)

Embodiments

The following description of embodiments of the invention is made with reference to the drawings, but these embodiments do not represent restrictions on the invention.

(0012)

Fig. 1 is a simplified drawing of a first embodiment of the bonding material for electronic parts of this invention; Fig. 2 is an explanatory drawing of the use of the bonding material for electronic parts of this invention; Fig. 3 is an explanatory drawing of the principle of maintaining conductivity in the bonding material for electronic parts of this invention. In the drawings, 1 is the bonding material for electronic parts; 2 is an insulating resin base material; 3 are particles of conductive shape memory alloy; 4 is the circuit substrate; and 5 is another circuit substrate.

(0013)

Insulating resins that do not melt at the temperatures of the bonded areas when used in the

bonded areas of electronic devices and moreover that adhere to metal material may be widely used as the insulating resin base material 2 of the bonding material for electronic parts 1 of this invention. As specific examples, resins using typical bonding material for electronic parts such as thermosetting resins like epoxy resins and the like, or thermoplastic resins like polyester, polyethylene, and the like, can be mentioned. Of these, resins in which cure approximately within the temperature range of 25~175°C do not cause thermal deterioration of electronic equipment and so are preferred.

(0014)

Shape memory alloys of Ti-Ni, Ag-Cd, Au-Cd, Cu-Au-n, In-Tl, IN-Cd, and Ti-Ni-Cu can be acceptably used as the conductive shape memory alloy. Of these, materials with a critical temperature at which shape memory (hereinafter "critical temperature"), in the range of approximately 25~200°C are preferable. Here, the shape memory alloy is represented as particles 3 and these are dispersed within the insulating resin base material 2, but there is no particular limitation on the particle size or dispersion density, and these may be selected as needed. Moreover, dispersal can initially distorted beforehand. For example, with an initial shape of a sphere having a diameter *d*, formed into a rugby ball shape after applying initial distortion, with the short diameter designated by the letter *n*, *n/d* is 0.2~0.9, and preferentially 0.4~0.6. When these particles 3 are dispersed within the insulating resin base material 2, the critical temperature is approximately the same or higher than the curing temperature of the resin base material 2, but it is preferable for the temperature difference between the two to be 30°C or less. With both of these having this sort of temperature difference, if the critical temperature is much higher than with the curing temperature of the resin base material 2, the shape recovery effect of the shape memory alloy begins when the curing of the resin is more less completed, and the particles 3 of the shape memory alloy do not fully recover, and as a result there is a risk that conductivity failures would occur.

(0015)

It is acceptable for the form of the bonding material for electronic parts of this invention to have a simple tape form, and is alternatively acceptable for it to be a tape in which local concavities are preformed to fit the pattern of the bonding parts of the electronic device that is used. Moreover, it may be a paste (or a gel).

(0016)

Referring to Fig. 2, we will next explain a bonding material for electronic parts 1 of the present invention in a tape form which represents an improvement over the prior art bonding material for electronic parts wherein a flat panel liquid crystal display and externally connected circuit are bonded. In this example, the insulating resin base material 2 has a film thickness of 20~30μm, and the particle size of the shape memory alloy particles 3 is 2~20μm.

(0017)

First, as in the prior art, this tape bonding material for electronic parts one is interposed between the circuit substrate 4 wiring pattern 4a and the circuit substrate 5 wiring pattern 5a, and heated and pressed for the required time period. The heating temperature of the insulating resin base material 2 is the ambient temperature curing temperature, for example, 150°C~170°C, and the pressure is 10 kg/cm^2~30 kg/cm^2. Also, the aforesaid required time period make, for example, be 20~40 seconds. As a result of this meeting and pressing the particles three of the conductive shape memory alloy are crushed to a thickness of approximately 1μm~3μm, and also the wiring pattern 4a and wiring pattern 5a are brought into compressive contact and the conductivity of both is maintained. Having done so, the connected circuit substrates 4, 5 are heated to the temperature at which the shape memory alloy shape recovery effect commences, for example to approximately 180°C.

(0018)

As a result, the particles 3 of the conductive shape memory alloy that have been crushed recover in their initial shape as shown in Fig. 3, and the pressing force in the directions indicated by the arrows in the figure with respect to the wiring pattern 4a and the wiring pattern 5a comes into effect. Thus, even if the volume of the insulating resin base material 2 increases due to a temperature rise in the use environment in due to thermal cycling, the particles 3 similarly deform so as to increase in the vertical direction of the figure due to their recovery force, and the connections between the wiring pattern 4a and the wiring pattern 5a are always maintained. As a result, there are no conductor failures due to the formation of gaps. Moreover, since and the particles 3 are in the aforesaid state, conductivity failures do not occur even when acted upon by external compressive or tensile forces.

(0019)

When a bonding material for electronic parts 1 in which particles 3 that have been initially distorted beforehand are dispersed is used, it is not necessary to apply the kind of high-pressure outlined above, and bonding can be effected at low pressure.

(0020)

In another embodiment of the present invention (hereinafter "the second embodiment"), the insulating resin base material to is a paste (gel). Apart from the fact that the insulating resin base material 2 in the second embodiment is a paste, the materials used for the insulating resin base material 2 and the particle sizes and dispersal density of the particles 3 of the shape memory alloy that are dispersed and contained are the same as those in the embodiment outlined above.

(0021)

The following is a description of chip bonding in an electronic device such as a diode, transistor, or the like in a surface mount or the like with the second embodiment. In this case, since the chip elements could be destroyed if the maximum pressure is applied, it is desirable to apply an initial distortion to the particles 3 of the shape memory alloy beforehand.

(0022)

First, the bonding material for electronic parts 1 in paste form is coated or printed to the desired thickness in the desired lead locations. It is preferable that this thickness be thicker than the diameter of the particles 3 (or the particle 3 thickness after applying pre-deformation when pre-deformation is applied). Next, the leads that are coated with the bonding material for electronic parts 1 in paste form are positioned on the desired locations of the chip. It is then heated in this state to the curing temperature of the insulating resin base material 2 of the bonding material for electronic parts 1. It is then pressed as desired. After so doing, it is heated to the critical temperature of the shape memory alloy particles 3. It is also acceptable for this heating to be done continuously with the preceding heating.

(0023)

The operation and effects obtained from this second embodiment are the same as those for the preceding embodiment. However, since the insulating resin base material 2 is in paste form, it can be spread over the desired range.

(0024)

The present invention has a thus been described on the basis of two embodiments thereof. However, the application of the bonding material for electronic parts is not limited to the above, and can be satisfactorily used in the bonding of electronic parts of all types or in the mounting of electronic devices. For example, it can satisfactorily be used for the bonding of semiconductor elements and lead frames in surface-type amounts, lead-type, and other electronic parts; the bonding of electrodes of electronic parts and circuit board wiring patterns in the mounting of surface-mount types, lead-types, and other electronic parts, flat-type display elements, thermal printing heads, and other circuit boards (including flexible substrates); as well as the bonding of contact pins to hybrid ICs, flat display elements, thermal printing heads, and the like.

(0025)

Effect of the Invention

As described above, by using the bonding material for electronic parts of the present invention to effect connections, good conductivity is always maintained even under environmental conditions in

which thermal cycling occurs or environmental conditions in which there is vibration. Moreover, the bonding material for electronic parts of this invention permits work to be performed at relatively low temperatures.

(0026)

Furthermore, electronic devices having joined parts using the bonding material for electronic parts of the present invention maintain excellent conductivity even under environmental conditions in which thermal cycling occurs or environmental conditions in which there is vibration, so it enhances the reliability of products such as a thermal printer heads, and the like.

Brief Description of the Drawings

Fig. 1 Simplified drawing of the bonding material for electronic parts of this invention.

Fig. 2 Explanatory drawing of the use of the bonding material for electronic parts of this invention.

Fig. 3 Drawing explaining the principles for maintaining conductivity in the bonding material for electronic parts of this invention.

Fig. 4 Simplified drawing of a prior art bonding material for electronic parts.

Fig. 5 Explanatory drawing of the use of a prior art bonding material for electronic parts.

Fig. 6 Drawing explaining the principles for maintaining conductivity in a prior art bonding material for electronic parts.

Symbols

1 Bonding material for electronic parts

2 Insulating resin base material

3 Conductive shape memory alloy particles

4 Circuit board on one side

5 Circuit board on the other side

Fig. 1

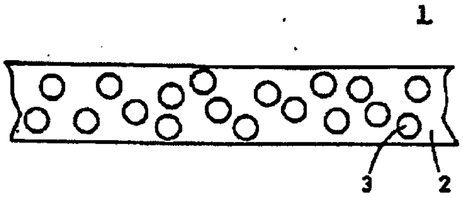

Fig. 2

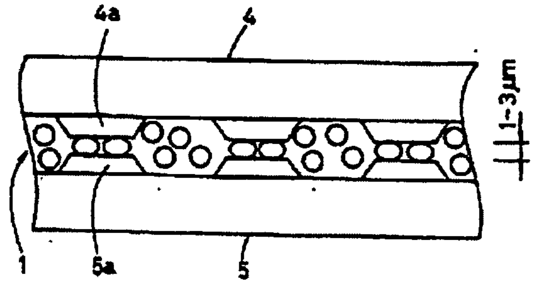

Fig. 3

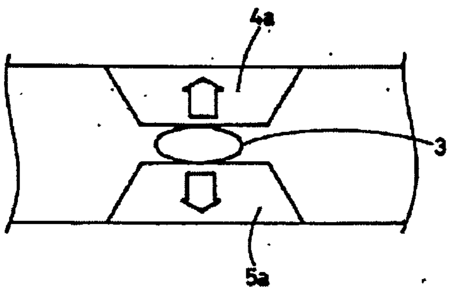

Fig. 4

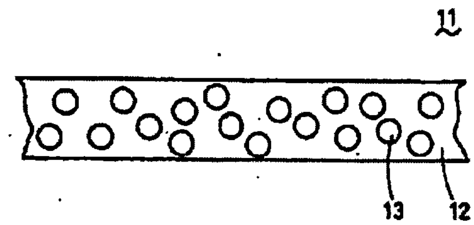

Fig. 5

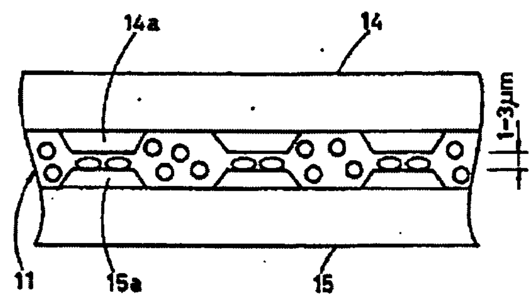

Fig. 6